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Overbite Correction and Smile Esthetics

Sherif Nabil Elhady
Virginia Commonwealth University

School of Dentistry
Virginia Commonwealth University

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Dr. Steven J. Lindauer, Thesis Director / Program Director Department of Orthodontics

Dr. Eser Tüfekçi, Committee Member, School of Dentistry

Dr. Omar Abubaker, Committee Member, School of Dentistry

Dr. Steven J. Lindauer, Chairman Department of Orthodontics, School of Dentistry

Dr. Laurie Carter, Director of Advanced Dental Education, School of Dentistry

Dr. F. Douglas Boudinot, Dean of the School of Graduate Studies

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OVERBITE CORRECTION AND SMILE ESTHETICS

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science at Virginia Commonwealth University.

by

SHERIF N. ELHADY
B.A., Virginia Polytechnic Institute and State University, 1999
D.D.S., Virginia Commonwealth University, 2003

Director: Steven J. Lindauer D.M.D., M.D.Sc.
Chairman of the Department of Orthodontics and Program Director

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Table of Contents

Page

List of Tables

Page

List of Figures

Page

Abstract

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Sherif N. Elhady, D.D.S.

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science at Virginia Commonwealth University.

Virginia Commonwealth University, 2005

Thesis Director: Steven J. Lindauer DMD, M.D. Sc.
Department of Orthodontics, Chairman and Program Director

The purpose of this prospective clinical study was to investigate differences in outcomes from two common treatment modalities used to reduce deep overbite: maxillary incisor intrusion using an intrusion arch and posterior tooth eruption using an anterior bite plate and to assess their influence on smile esthetics. Pre-treatment and post-overbite correction records were gathered from 40 patients with deep overbite malocclusions at the Virginia Commonwealth University orthodontic clinic. Intrusion arch patients displayed significant reductions in maxillary incisor display accompanying documented incisor intrusion. Bite plate patients showed significant lower incisor intrusion and increases in the mandibular plane angle. When compared to the bite plate group, there was a greater tendency for flattening of the smile arc seen in the intrusion arch group. Changes in the smile arc were likely partially a result of

the mechanics used but may also have been due to other factors involved in orthodontic tooth alignment.

Introduction

Enhancement of the smile is a major objective of orthodontic treatment. Attempts have been made to define and quantify the smile characteristics that are considered to be ideal. Defining these characteristics enables practitioners to set goals for individualized treatment. Some suggestions have been made regarding treatment strategies that should be used to maintain or produce ideal esthetics, but no evidence has been presented to substantiate these approaches. Despite the recent use of digital videography to analyze the smile,[1] routine smile diagnosis still involves some degree of subjective evaluation.

Frush and Fisher[2] were among the first to describe the paralleling curvature that should exist between the maxillary anterior teeth and the curvature of the upper border of the lower lip. Peck, Peck, and Kataja's article in 1992 entitled "The gingival smile line,"[3] introduced the concept that smile esthetics could actually be studied scientifically and discussed in the orthodontic literature. Ackerman et al[4] offered the "smile mesh" as a tool for measuring smile esthetics and popularized the term "smile arc", previously described by Hulsey[5] and Frush and Fisher[2] as the "smile line", to describe the relationship between the upper anterior teeth and the contour of the lower lip. Smile arcs were classified as "consonant" if the incisal edges of the maxillary teeth followed the contour of the lower lip, "flat" if they were straight, and "reverse" if they were aligned in an arc opposite to the lower lip line.[4] With attempts having been made to quantify and

analyze this characteristic of the smile scientifically, the subjective nature of smile arc evaluation has not been determined.

Mackley[6] compared changes in the smile achieved during orthodontic treatment using four defined criteria: overall attractiveness, maxillary incisor torque, dental protrusion, and profile evaluation and found an improvement in all areas. Patients whose smiles improved the most, as evaluated by both parents and orthodontists, on average displayed an increase in maxillary incisor torque and decrease in maxillary incisor show below the upper lip. He concluded that proper vertical positioning of the anterior teeth was necessary to maximize the orthodontist's potential for improving the smile.

Goldstein[7] recently contrasted the features of a "youthful smile" which exhibits consonance with that of an "older smile" that tends to be flatter. The differences in attractiveness of these two smile types were studied by Hulsey[5] in his evaluation of 20 orthodontically treated patients and 20 patients with "normal occlusion". He found that smiles that were judged most attractive had a more harmonious relationship between the upper incisor line and the lower lip contour, displayed symmetry, had an upward curving upper lip, and neither an excessively long nor short upper lip. Interestingly, orthodontically treated smiles were judged to be less attractive than untreated smiles of subjects with normal occlusion. However, the smiles compared were not from the same patients before and after treatment.

Ackerman et al[4] evaluated the posed smiles of 30 orthodontically treated individuals before and after treatment and 30 untreated individuals over a 2.5 year period. A statistically significant decrease in lip drape, increase in smile width and increase in maxillary inter-canine width were found for treated individuals. They found that untreated individuals and treated patients showed changes of 13% and 40%, respectively, to the smile arc. Only 5% of the untreated group had a flattening of the smile arc while 33% of the treated patients exhibited a flatter smile arc after treatment. Even though the smiles flattened during treatment, the change in attractiveness was not investigated.

Dynamic esthetic measures have generally been considered unreliable because of the involvement of the facial musculature.[8] However, reproducibility of a posed smile has shown to be consistent as described in several studies. Hulsey[5] found that a repeatable natural smile could be produced while Rigsbee[9] found that an unstrained posed smile could be produced consistently. These findings were also recently confirmed by Ackerman et al[4] using the Smile Mesh. Even though a smile is reproducible, the question remains as to the subjectivity of the smile arc evaluation. Hulsey[5] examined this question and found high intra-examiner reliability but great variability in inter-examiner agreement.

In order to better control and improve the smile arc during treatment, several authors have suggested that careful bracket positioning is important.[10,11] A vertical difference of anywhere from 0.5 to 1.5 mm in bracket placement between the maxillary

central and lateral incisors has been advocated.[10,11] In a case report, Sarver and Ackerman[10] showed that careful leveling without intrusion of the maxillary incisors was important to preserve a favorable smile arc. Intrusion of mandibular, rather than maxillary, incisors to control overbite was suggested by Zachrisson[11] and Sarver[12] for preserving smile esthetics. Vertical steepening of the occlusal plane either by growth modification or surgically, has also been advocated by Sarver and Ackerman[10] and Sarver[12] to alter geometrically the relationship of the maxillary anterior curvature relative to the lower lip for improvement of the smile arc.

Authors have speculated on the various mechanical interventions achieved by orthodontists that may cause a patient's smile arc to flatten during treatment. It has been suggested that broadening the maxillary arch may flatten the appearance of the smile arc.[1,10] Sarver[12] stated that "maxillary intrusion arches or maxillary arch wires with accentuated curve could result in a flattening of the smile arc." Ackerman and Ackerman[1] said they found that "the segmented-arch technique using cantilever springs offers better control of leveling" and that "leveling with a continuous arch wire will intrude the maxillary central and lateral incisors and thus flatten the smile arc." Zachrisson[11] also cautioned against over intrusion of maxillary incisors in patients with low lip lines because it decreased the lip to tooth relationship. He did advocate such intrusion, however, for patients with high lip lines. Despite these recommendations,

however, there have been no published studies of the effects of specific orthodontic mechanical interventions on the esthetics of the smile.

The purpose of the present study was to examine and compare the effects of two commonly used treatment interventions for correcting excessive overbite: maxillary incisor intrusion and posterior tooth eruption, on two factors involved in smile esthetics: the lip to tooth relationship and the smile arc. The design was a prospective clinical trial in which patients underwent one of the two procedures for correction of deep overbite. Various measures of tooth movement and esthetic changes were made and compared between the two groups. A pilot study was conducted to determine the reliability of the smile arc assessment among orthodontic examiners.

Materials and Methods

Overview

Institutional Review Board (IRB) approval was granted to conduct a study comparing the effects of two treatment interventions to correct deep overbite: maxillary incisor intrusion using an intrusion arch and posterior tooth eruption using an anterior bite plate. Patients presenting to the Virginia Commonwealth University Orthodontic Clinic were asked to participate in the study if they had at least 50% overbite at the start of treatment and were over 10 years of age. Patients with Sella-Nasion to Mandibular Plane angles of greater than 40° and patients with extractions planned as part of treatment were excluded from the study. The treatment method for each patient, intrusion arch or bite plate, was determined by the orthodontic resident and attending to be the best treatment to reduce overbite for that particular patient. However, the procedure used was largely dependent on the day of the week the patient chose to be treated because different attending orthodontists tended to implement their own preferred overbite correction method consistently.

Intra-Examiner Reliability

Reproducibility of the clinical lip to tooth measurement and amount of gingival display on smile was tested by evaluating these parameters in an untreated group of 20 volunteers at two time points at least one week apart as described by Lindauer et al.[13] Intra-examiner reliability was evaluated for two examiners for the clinical lip to tooth measurement and for one examiner for the gingival display on smile parameter.

Inter-Examiner Reliability of Smile Arc Assessment

Inter-examiner reliability of the smile arc assessment was evaluated among 17 orthodontists to determine the subjectivity of the assessment. Each orthodontist evaluated 20 close-up smile photographs constituting a random sample of patients from the study. Instructions were given to the evaluators to assess each smile as being consonant, flat, or reverse in relation to the vermillion border of the lower lip.

Subjects and Measurements

A total of 60 patients agreed to participate in the study, 31 in the intrusion arch group and 29 in the bite plate group. Of those patients, 40 had data collected at the pre-treatment and post-overbite correction stages for analysis: 20 intrusion arch and 20 bite plate patients. Seventeen of remaining patients never received the planned treatment, two patients moved during treatment, and one patient had incomplete records. Extra-oral

natural smile photographs and cephalometric radiographs were taken before and after overbite correction. The cephalometric measurements used in this study are described in Figure 1 and Table I. In addition, a clinically-determined lip to tooth measurement to the nearest 0.5 mm was made for all the patients as previously described by Lindauer et al.[13] The gingival smile line was evaluated by one examiner for 20 patients before and after overbite correction by measuring the gingival display during a natural smile as described by Zachrisson.[11] The center of the right central incisor was used for consistency. Smiles showing no gingival display were assigned a negative value to describe the amount of lip coverage over the incisors. The smile arc assessments (consonant, flat, or reverse) were made as recommended by Sarver and Ackerman [14] by the same examiner clinically before and after overbite correction.

For the intrusion arch patients, the techniques employed were either that advocated by Burstone[15] or Isaacson[16] and were used in the maxillary arch only. Bite plate patients received either a removable or fixed maxillary acrylic bite plate that contacted the lower incisors to prevent posterior occlusal contact. In both groups, aligning arch wires in addition to the overbite correction appliance were placed in most patients during the overbite correction phase of treatment.

Pre- and post-overbite correction cephalometric films were superimposed on the anterior cranial base to determine skeletal and dental changes occurring in each patient during treatment. For each patient, a maxillary and mandibular incisor center of

resistance was defined as one half of the root length in the alveolar process on the pre-treatment cephalometric film and carried forward to the post-overbite correction incisors. An incisor template was used to standardize this process. The pre-treatment functional occlusal plane was transferred to the post-overbite correction radiograph to serve as a stable reference plane for describing tooth movements. Linear measurements made inferior and perpendicular to the functional occlusal plane were assigned negative values.

Statistics

To examine intra-examiner reliability of the lip to tooth and gingiva smile, measurements made at least one week apart were evaluated using paired t-tests to assess significant differences and correlation between measurements. To evaluate inter-examiner reliability of the smile arc assessment, the percent agreement among raters for each rated smile was calculated. The kappa coefficient, evaluating the degree of agreement between raters, was determined for each pair of raters and an average kappa value for each rater was calculated.

Differences between pre-treatment cephalometric and clinical measurements were evaluated using paired t-tests with $P < .05$. Cephalometric and clinical measurement changes as a result of overbite correction were evaluated within groups using paired t-tests and between groups using multiple t-tests. Using the Bonferroni correction, the P-value for significance was set at $P = 0.001$ to compare changes within each group during

treatment. The P-value for significance was set at $P < .003$ using the Bonferroni correction to compare average differences with treatment between groups. Smile arc changes within and between groups were evaluated using Chi Square analysis.

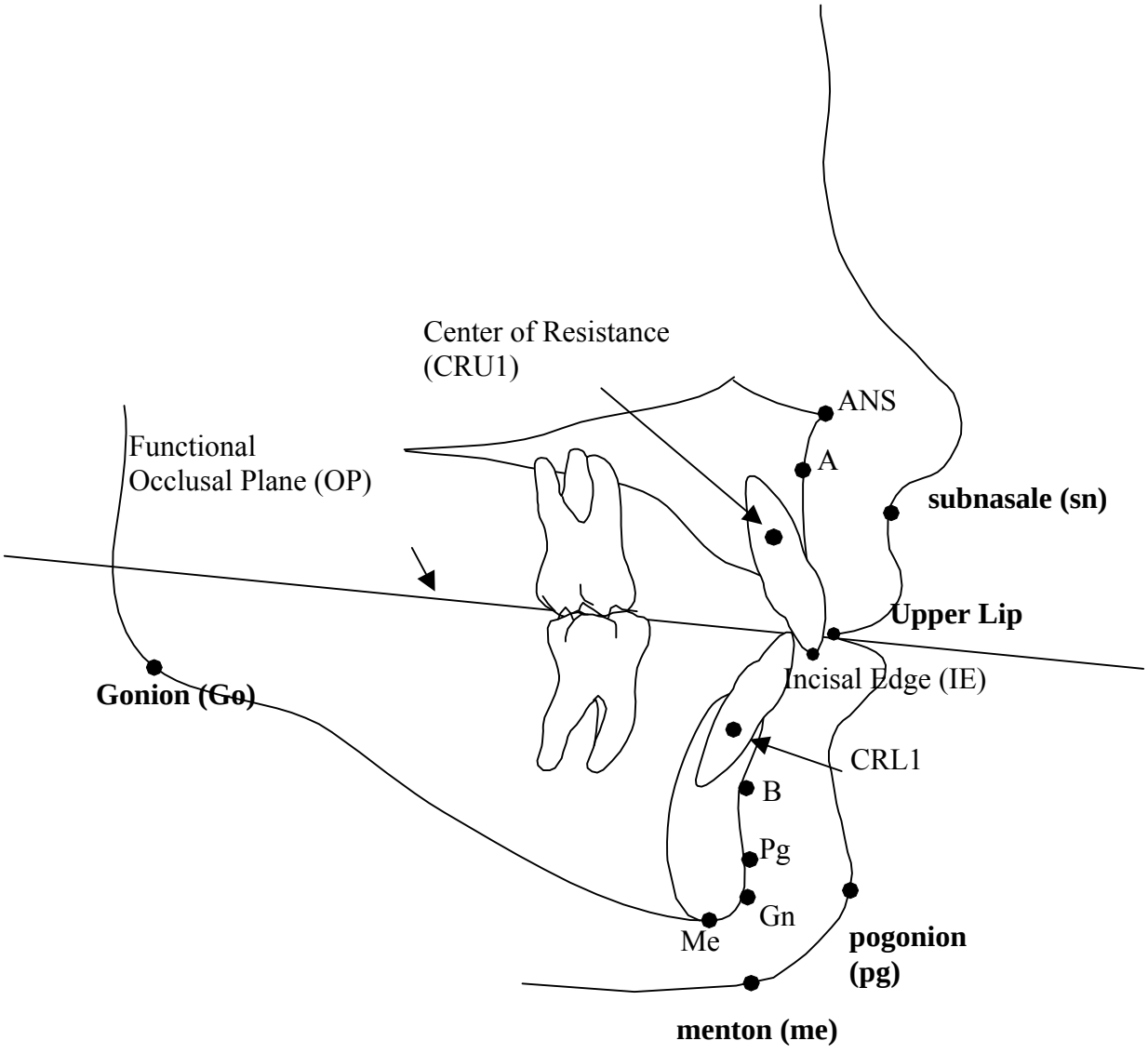

Figure 1. Cephalometric Measurements

Table I. Description of Cephalometric Measurements.

Measure	**Definition**
OB	Overbite measured perpendicular to the functional occlusal plane.
Lip-Tooth	Vertical distance from the upper incisor incisal edge to Stomion perpendicular to the functional occlusal plane.
OP-U1IE	Vertical distance from the upper incisor incisal edge to the functional occlusal plane.
OP-CRU1	Vertical distance from the upper incisor constructed center of resistance to the functional occlusal plane.
OP-CRL1	Vertical distance from the lower incisor constructed center of resistance to the functional occlusal plane.
SN-U1	Angulation of the upper incisor relative to Sella-Nasion.
MP-L1	Angulation of the lower incisor relative to the Mandibular Plane.
SN-MP	Mandibular Plane angle.

Results

Intra-Examiner Reliability

Reproducibility of the lip to tooth measurements made clinically on untreated volunteers by both examiners showed no significant differences between the first and second measurements ($P > .20$) and showed a high correlation ($R \geq .90$).

Reproducibility of the gingival display on smile measurements made clinically on untreated volunteers suggested that these values are reliable to within 0.5 mm. Gingival display on smile measures in the group averaged -1.8 ± 2.0 mm and ranged from –4.5 to 2.0 mm. A paired t-test showed no significant differences between the first and second measurements ($P = .31$) and strong correlation between the first and second gingival display on smile measurements ($R = .96$).

Inter-examiner Reliability of Smile Arc Assessment

The percentage agreement of each rated smile among orthodontists was calculated and ranged from 47% to 100%. The percentage agreement represents the amount of agreement among orthodontists of the most frequently occurring smile evaluation (ie. consonant, flat, reverse). The kappa coefficient was calculated between each pair of orthodontists to evaluate the level of agreement between each pair of raters. An average kappa coefficient was then calculated for each orthodontist as shown in Table III. Eleven

of the seventeen orthodontists had average kappa coefficients with only moderate agreement. The remaining raters were fair to poor in agreement. Overall agreement was fair with an average kappa coefficient of .39.[17]

Clinical and Cephalometric Measurements

Pre-treatment and post-overbite correction averages for clinical and cephalometric measurements for the two groups are shown in Table II. There were no significant pre-treatment differences between the groups for any of the clinical or cephalometric characteristics measured.

Significant changes in measurements from pre-treatment to post-overbite correction within each group are indicated in Table II. Both the intrusion arch ($P < .0001$) and bite plate ($P < .0001$) groups showed significant decreases in overbite with treatment. The lip to tooth distance decreased significantly in the intrusion arch and bite plate groups both as measured clinically ($P < .0001$ and $P < .001$, respectively) and cephalometrically ($P < .0001$ and $P < .0001$, respectively). Both the incisal edge ($P < .0001$) and center of resistance ($P < .001$) of the maxillary central incisor moved apically in the intrusion arch group. Some apical movement of the incisal edge was also seen in the bite plate group but it was not statistically significant. In the bite plate group, the lower incisor flared ($P < .0001$) and its center of resistance moved apically ($P < .0001$). Significant lower incisor flare ($P < .0001$) was also observed in the intrusion arch group

but apical movement of the center of resistance was not statistically significant. There was a statistically significant increase in the mandibular plane angle in the bite plate group ($P < .0001$).

The overbite correction procedure duration averaged 4.8 ± 1.8 months for the intrusion arch group and 3.6 ± 1.1 months for the bite plate group, however the difference was not statistically significant ($P = .01$). Average changes recorded during treatment for each group are shown and compared in Table II. While both the intrusion arch and bite plate patients had an average decrease in clinically measured lip to tooth distance during treatment, that decrease was significantly greater in the intrusion arch group ($P < .0001$). This was the only change found to be significantly different between the groups as a result of overbite correction.

Table II. Pretreatment, Post-Overbite Correction, and Treatment Change Averages.

Measure	Pre-treatment mean (± SD)			Post-overbite correction mean (± SD)		Treatment Change mean (± SD)		
	Intrusion Arch	Bite Plate	P-value	Intrusion Arch	Bite Plate	Intrusion Arch	Bite Plate	P-value
Clinical Lip-Tooth (mm)	5.9 (1.9)	5.5 (1.1)	.45	3.9 (1.9) **	4.8 (1.2) *	-2.0 (1.2)	-0.7 (0.7)	< .0001***
Gingiva on Smile† (mm)	.88 (1.9)	-0.2 (1.2)	.17	-.82 (2.5)	-.36 (1.5)	-0.88 (1.4)	-0.20 (0.59)	.18
OB (mm)	4.8 (1.1)	5.1 (1.7)	.50	2.1 (0.89) **	2.1 (1.4) **	-2.7 (1.3)	-3.0 (1.5)	.54
Ceph Lip-Tooth (mm)	5.4 (1.9)	5.2 (.99)	.64	3.5 (1.8) **	4.1 (1.1) **	-2.0 (0.99)	-1.1 (0.68)	.003***
OP-U1IE (mm)	-2.1 (1.6)	-2.1 (1.5)	1.0	-0.53 (1.7) **	-1.35 (1.4)	-1.6 (1.1)	-.73 (1.0)	.015
OP-CRU1 (mm)	13.7 (1.3)	13.8 (1.3)	.85	14.7 (1.3) *	14.0 (1.4)	0.99 (0.98)	0.23 (1.2)	.032
OP-CRL1 (mm)	-12.7 (1.7)	-12.3 (1.5)	.50	-13.6 (1.7)	-14.3 (1.7) **	0.95 (1.7)	2.0 (1.6)	.058
SN-U1(°)	98.8 (8.2)	98.8 (11.0)	.99	104.7 (5.4)	104.7 (8.5) *	5.9 (7.0)	5.9 (5.9)	.99
MP-L1(°)	93.6 (7.6)	96.0 (7.4)	.31	98.0 (8.9) **	100.5 (6.5) **	4.4 (4.1)	4.5 (3.3)	.92
SN-MP(°)	31.4 (6.1)	29.8 (4.8)	.35	32.0 (5.9)	31.4 (4.8) **	0.6 (1.2)	1.6 (1.2)	.010

* Significant changes recorded within groups during treatment at $P < .001$
** Significant changes recorded within groups during treatment at $P < .0001$
*** Significant at $P \leq .003$
† Number of subjects measured = 10 in each group

Smile Arc Assessment

In the intrusion arch group, 19 of the 20 patients were evaluated as having a consonant smile with one patient having a flat smile before treatment. In the bite plate group, 17 of the 20 patients had a consonant smile, two had flat smiles, and one had a reverse smile before treatment. Following overbite correction, 13 of the 20 smiles in the intrusion arch group and 6 of the 20 smiles in the bite plate group were evaluated as having become flatter. No change in the smile arc was seen in 6 of the 20 intrusion arch patients and 14 of the 20 bite plate patients. One patient's smile arc became more consonant in the intrusion arch group while none improved in the bite plate group. The smile arc changes between the groups were statistically different ($P < .05$) with patients in the intrusion arch group significantly more likely to experience flattening during overbite correction.

Table III. Average Kappa Coefficients of Raters.

Rater	Average Kappa
1	.51
2	.49
3	.49
4	.47
5	.44
6	.44
7	.43
8	.42
9	.42
10	.42
11	.42
12	.39
13	.38
14	.34
15	.33
16	.18
17	.14
Average	.39

Discussion

The results of this study demonstrate that two different mechanisms commonly used to correct deep overbite in orthodontic patients do indeed accomplish this correction in different ways. Both intrusion arches and bite plates were shown to be successful in correcting deep overbite. Maxillary incisors in the intrusion arch group were significantly intruded during treatment and there was a corresponding decrease in the lip to tooth measurement as assessed both clinically and cephalometrically. Flaring of the mandibular incisors in the intrusion arch group was most likely due to the concomitant leveling of the mandibular arch during treatment. Though overbite was also effectively reduced in the bite plate group, the data suggest that overbite correction was achieved in these patients by a combination of lower incisor intrusion, incisor flaring, and a statistically significant opening rotation of the mandibular plane secondary to probable posterior tooth eruption.

Overbite correction using intrusion arches in growing patients is not well documented in the literature. Using an intrusion arch and a cervical headgear, Al-Buraiki et al[18] showed a significant opening rotation of the mandible accompanied by insignificant changes in the vertical height and flare of the upper incisors. Overbite correction was attributed to incisor intrusion and extrusion of maxillary molars. Weiland et al[19] showed significant overbite correction in an adult sample using the segmented arch

technique with no accompanying opening rotation of the mandible. Overbite correction of 3-3.5 mm was reported with upper incisor intrusion of 1.5 mm. Costopoulos and Nanda,[20] in a slightly older sample than the current study, demonstrated 1.9 mm of intrusion. Values for overbite correction and incisor intrusion from these studies are comparable to values obtained in the current study. However, there have been no previous studies assessing the tooth movements associated with correction of overbite using an anterior biteplate.

According to Mackley,[6] one of the most important factors associated with improvement of the smile was a decrease in maxillary incisor show during orthodontic treatment. This is in contrast to Zachrisson's[11] recommendation to avoid excessively decreasing the lip to tooth distance. Of course, the final determination of vertical anterior tooth positioning goals must be made on an individual basis. If decreasing the lip to tooth distance is an objective of treatment, the results of the current study show that intrusion mechanics is an effective means of accomplishing a favorable outcome.

The purpose of the current study was to evaluate the effects of two different methods of overbite correction and compare changes in anterior tooth display and the smile arc. Patients in the intrusion arch group were significantly more likely to experience flattening of the smile arc during overbite correction than patients in the bite plate group. However, 30% of patients in the bite plate group also experienced flattening of the smile arc. It is likely that flattening of the smile arc is caused by several factors

including bracket placement, excessive incisor intrusion, and orthodontic alignment unrelated to the overbite correction procedure. More flattening of the smile arc in the intrusion arch group may be due to over intrusion present temporarily at the end of the overbite correction phase.

As the patients involved in the current study continue to be followed over time, it will be interesting to see how cephalometric measures and clinical parameters, especially lip to tooth and the smile arc, change as treatment progresses to completion. For intrusion arch patients particularly, it is possible that lip to tooth distances will increase as incisors that were intruded apical to the functional occlusal plane erupt back to the level of occlusion with the use of straight arch wires during subsequent treatment. Any flattening effect of intrusion mechanics on the smile arc may likewise decrease over time as continuous wires are used to refine alignment of the dentition. Evaluation of these patients during retention may also yield some interesting results. An increase in overbite has been shown to occur consistently after treatment.[18,21] This may result in smiles that become more consonant over time during retention.

An opening rotation of the mandibular plane, as observed in the bite plate patients in this study, may occur due to either molar extrusion without compensation in the vertical growth of the ramus or increased vertical growth of the posterior maxilla. Having excluded patients with excessive vertical skeletal dimensions from the study and considering the short treatment time observed, it is more likely that the mandibular plane

steepening observed occurred due to molar extrusion secondary to posterior disclusion from the bite plate. The treatment effects of an anterior bite plate to correct the curve of Spee are not well documented in the orthodontic literature. It will be interesting to see whether steepening of the mandibular plane is maintained during the later stages of treatment.

With the prospective nature of this study, there may have been an inherent bias of the two groups that was not controlled. The treatment modality chosen may have been selected with reference to the vertical position of the upper incisors before treatment. The intent was to allow practitioners to use their preferred method. However, it is possible that they anticipated different results from different methods of overbite correction thus leading to selection bias. However, no pre-treatment differences in any parameters were found between the intrusion arch and bite plate groups.

The moderate to poor agreement in smile arc determination among orthodontists rating a series of smiles brings into question the usefulness of this characteristic as a diagnostic or outcome measure. However, high levels of agreement were recorded for some smiles that appeared to be more extreme, clearly consonant or clearly reverse, with lower levels of agreement recorded for smiles that were borderline, consonant to flat, or flat to reverse.

In an evolving age of orthodontics where the specialty has gone beyond just looking at straight teeth or nice plaster models, there has been a renewed emphasis on the

smile and its characteristics. This study has shown that the different mechanics used in overbite correction indeed do affect the smile arc differently during treatment. As the study goes to completion, questions will be answered about the post-treatment and long term stability of the changes detected.

Conclusions

Both intrusion mechanics and use of an anterior bite plate proved to be effective means of reducing overbite in a sample of patients presenting with deep overbite before orthodontic treatment. The mechanism of correction was significantly different between the two treatment procedures with the intrusion arch group demonstrating significant maxillary incisor intrusion accompanied by a significantly greater decrease in maxillary anterior tooth display. Bite plate patients exhibited lower incisor intrusion, significant flaring of the lower incisors, and a small but significant increase in the mandibular plane angle. Significantly more patients in the intrusion arch group experienced flattening of the smile arc during overbite correction than in the bite plate group. The data from this and previous studies suggest that flattening of the smile arc is a common occurrence during orthodontic treatment. The evaluation of the smile arc was found to be a reproducible subjective criterion only under certain circumstances where the smile was close to perfect harmony or when the deviation away from consonance was very high. Overall agreement among orthodontists evaluating a smile arc was moderate to poor.

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Appendix A- Intrusion Arch Group

Before **After**


C.D.


C.J.L.


M.A.


J.B.


B.G.


N.A.K.


J.M.


P.O.


S.S.


D.V.


H.M.


R.L


K.P.


P.E.


L.B.


J.S.


B.O.


M.P.


L.D.

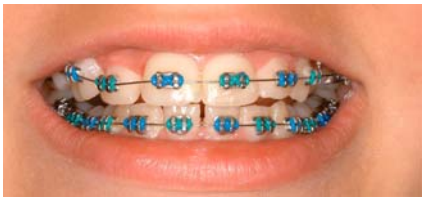

S.R.

Appendix B- Bite Plate Group

Before **After**


D.C.


I.C.

C.W.


T.J.


L.J.


M.A.


C.W.


M.M.


P.S.


B.G.


T.M.


N.T.


A.L.


L.C.


B.D.



J.M.


S.R.


L.L.


R.W.

VITA

Dr. Sherif N. Elhady was born in Salem, Virginia on April 3, 1979. He attended Virginia Polytechnic Institute and State University from 1996-1999, where he received a Bachelor of Arts degree in Biochemistry. He then matriculated at Virginia Commonwealth University where he earned his Doctor of Dental Surgery degree in May 2003. He plans to enter private practice in Manassas, Virginia.